U.S. COAST GUARD
TESTING *and* DEVELOPMENT DIVISION

OFFICE OF ENGINEERING WASHINGTON, D.C.

REPORT

FIELD TESTING AND DEVELOPMENT UNIT

REPORT NO. 202

PROJECT CGTD J28-3/3-1-2(e)
ADDITIONAL TESTS TO DETERMINE EFFECT OF GASOLINE AND OIL ON APPROVED KAPOK LIFE PRESERVERS

Original

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ADDITIONAL TESTS TO DETERMINE EFFECT OF GASOLINE AND OIL ON APPROVED KAPOK LIFE PRESERVERS.

By

FIELD TESTING AND DEVELOPMENT UNIT
U. S. COAST GUARD YARD
Curtis Bay, Baltimore 26, Maryland

Date: 18 NOV 1959

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Commanding Officer

Date: 23 Nov 1959

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Chief, Testing and Develop ment Division
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U. S. Coast Guard Headquarters
Washington 25, D. C.

Original

ABSTRACT

Previous tests have shown that there is a serious loss in buoyancy of kapok life preservers (without PVC envelopes) when subjected to agitation in water with a thin film of gasoline or kerosene.

These past projects were carried out using fresh water and the performance tests were done by immersing life preservers in a gasoline or kerosene film for a continuous period of 12 hours.

In carrying out tests in this project, salt water was used for control test purposes. In addition, data was collected for loss of buoyancy when immersed in an oil film for thirty to sixty minutes and then removed from the oil film and immersed in salt water for a total of 12 hours. All the immersions were done with agitation.

In order to round out the available data on the effects of gasoline and oil, sixty used life preservers of known vintage and history were subjected to tests. The specimens were divided into two groups for tests: One group five years old or over, and another group under five years old.

The results of tests in this project do not follow the same trend as past tests. However, it showed that about 90% of the older preservers and about 50% of the newer preservers will fail in less than 12 hours when agitated in sea water (with or without gasoline and fuel oil films). Jackets with the same history showed large differences in performance.

FIELD TESTING AND DEVELOPMENT UNIT

PROJECT CGTD J28-3/3-1-2(e)

ADDITIONAL TESTS TO DETERMINE EFFECT OF GASOLINE AND OIL ON APPROVED KAPOK LIFE PRESERVERS

I

SCOPE

1. Introduction: In the past several years a number of tests have been conducted to determine the effect of gasoline and kerosene upon the buoyancy of Kapok life preservers (without polyvinyl chloride envelopes). The results of these tests have shown that serious losses of buoyancy occur when the preservers are subjected to agitation in water upon which a thin film of gasoline or kerosene is present. These results could compromise the acceptance of these jackets as approved items of life saving equipment. A decision to with draw approval of this type of jacket could have far reaching economic consequences. Accordingly, it was desired to conduct further tests, under as close to actual sea conditions as possible, to provide sufficient data upon which to base such a decision.

2. Statement of the Problem: To perform twelve (12) hour agitation - buoyancy tests on thirty (30) Model 2 Kapok jackets under five (5) years old, and thirty (30) Model 2 Kapok jackets over five (5) years old. The ten (10) jackets used in each of the following tests included five (5) jackets over five (5) years old and five (5) jackets under five (5) years old.

(a) Ten (10) jackets in salt water for twelve (12) hours as a control test.

(b) Ten (10) jackets in gasoline film on sea water for twelve (12) hours as a control test.

(c) Ten (10) jackets - ½ hour in gasoline film on sea water, then 11½ hours in plain sea water.

(d) Ten (10) jackets - 1 hour in gasoline film on sea water, then 11 hours in plain sea water.

(e) Ten (10) jackets - ½ hour in kerosene film on sea water, then 11½ hours in plain sea water.

(f) Ten (10) jackets - 1 hour in kerosene film on sea water, then 11 hours in plain sea water.

II

AUTHORITY

3. The tests described herein were undertaken by authority of Commandant (ETD) letter dated 25 August 1959, file CGTD J28-3/3-1-2(e).

III

PREVIOUS INVESTIGATIONS OF A SIMILAR NATURE

4. Previous investigations are as follows:

4.1 FTDU Report Number 146 dated 3 July 1957; Project CGTD J28-3/3-1-2, "Effect of contact with Gasoline and Oils on Approved Kapok Life Preservers and Buoyant Vests.

4.2 FTDU Report Number 147 dated 22 July 1957; Project CGTD J28-3/3-1-2 (a), "Effect of Contact with Gasoline and Oil on Approved Coast Guard Fibrous Glass Life Preservers and Unicellular Plastic Buoyant Vests".

4.3 FTDU Report Number 155 dated 25 October 1957; Project CGTD J28-3/ 3-1-2(b), "Additional Tests on the Effect of Contact with Gasoline and Oils on Coast Guard Approved Life Preservers.

4.4 FTDU Report Number 167 dated 23 June 1958; Project CGTD J28-3/3-1-2 (c), "Effect of Contact with Gasoline and No. 1 Fuel Oil on Kapok Model AK Buoyant Vests".

4.5 FTDU Report Number 194 dated 14 August 1959; Project CGTD J28-3/ 3-1-2(d), "Additional Tests to Determine Effects of Gasoline and Oil on Approved Kapok Life Preservers.

IV

PRESENT INVESTIGATION

5. Description of Material Under Test.

5.1 Thirty (30) of the jackets tested were Model 2 Adult Kapok life preservers manufactured by the Atlantic and Pacific Mfg. Corp., in accordance with Coast Guard Specification 160.002. These jackets had been in service for over five (5) years and bear FTDU identification numbers 1 through 35.

5.2 The remaining thirty (30) jackets were of the same type but had been in service for less than five (5) years. They bear FTDU identification numbers, 36 through 70. Seventy (70) jackets were available for tests involving only sixty (60) jackets.

The extra ten (10) preservers were to be used as spares if for some reason any of the tests were interupted before completion.

5.3 A history of the jackets tested, so far as is available, is presented on pages 4, 5, 6, and 7 respectively. The history data is based upon the following:

(a) Name of jacket manufacturer.

(b) Coast Guard Approval Number.

(c) Date of factory inspection "Approval Stamp".

(d) Name and type of vessel on shich used.

(e) Approximate time in service.

(f) Method and place of stowage.

(g) Approximate temperature range of stowage compartments.

(h) How used aboard ship.

(i) Additional information or remarks considered pertinent.

6. Description of Tests Conducted:

6.1 Of the seventy (70) jackets shipped to FT&DU all were tagged with corrosion resistant number tags. Agitation tests were conducted using an apparatus designed for previous tests of the same type. This time, however, modifications were made to the basic design to accomodate four (4) jackets at a time instead of two (2). Figure 1, page 8 shows the motor and crank assembly used. The machine consists essentially of a two throw crank shaft driven by an air motor. Each crank throw is connected to two weighted baskets by means of a rope and fair lead sheave on opposite throw journels of the crank shaft. The jackets under test were tied to the outside of the baskets (Figure 3, page 9). Sufficient ballast was added to the baskets to insure complete submergence during operation. The buoyancy was taken as the difference between the weight of the basket plus the ballast in water and the weight of the jacket in water during testing operations. In testing, the machinery is stopped every five (5) minutes to measure buoyancy until a rate of buoyancy change is determined. During the 'stop' period, the fuel film is replenished to the required thickness. Once this was done the time between readings was lengthened if the rate of change of buoyancy was found not to be too rapid. This would tend to simulate more closely the supposed conditions of a jacket being acted upon by a seaway.

History of jackets bearing FTDU Identification Numbers 1 through 10.

Ten (10) adult Model 2 Kapok Life Preservers.

MANUFACTURER -	Atlantic & Pacific Mfg., Co.
APPROVAL NO. -	B-233
DATE OF FACTORY INSP. -	1946
NAME & TYPE OF VESSEL -	"FIRE ISLAND PINES" Passenger vessel ("T") on a "Rivers" route between Sayville, L.I., N. Y. and Fire Island, N. Y.
APPROX. TIME IN SERVICE -	11 Years
METHOD & PLACE OF STOWAGE -	Folded and stowed in boxes. Same boxes also serve as seats.
APPROX. TEMP. OF STOWAGE -	Boxes are exposed to the weather so the temperature would vary from below freezing in the winter to approximately 100° in the summer.
HOW USED ABOARD VESSEL -	These life preservers have never been used as far as known. They remain stowed in boxes the year around and are only removed at times of inspection.

History of jackets bearing FTDU Identification Numbers 11 through 19.

Nine (9) Model 2 Kapok Life Preservers.

MANUFACTURER -	Atlantic & Pacific Mfg., Co.
APPROVAL NO. -	B-233
DATE OF FACTORY INSP. -	1945
NAME & TYPE OF VESSEL -	Vessel - Motor Boat "Capt. Walt." - Passenger party fishing boat.
APPROX. TIME IN SERVICE -	10 Years
METHOD & PLACE OF STOWAGE -	Stowed on deck in box since 1958, prior to that they were stowed in cabin.
APPROX. TEMP. OF STOWAGE -	Normal outside temperature of Belmar, New Jersey 12 months each year.
HOW USED ABOARD VESSEL -	Lifesaving equipment.

History of jackets bearing FTDU Identification Numbers 20 through 35.

Sixteen (16) Model 2 Kapok Life Preservers.

MANUFACTURER -	Atlantic & Pacific Mfg., Corp., and various others as per stencil.
APPROVAL NO. -	B-233
DATE OF FACTORY INSP. -	Passed Oct. 1945, and various others as per stencil.
NAME & TYPE OF VESSEL -	Vessel: Motor Boat "Capt. Walt" - Passenger Party Fishing Boat.
APPROX. TIME IN SERVICE -	10 Years
METHOD & PLACE OF STOWAGE -	Stowed on deck in box since 1958; prior to that they were stowed in cabin.
APPROX. TEMP. OF STOWAGE -	Normal outside temperature of Belmar, New Jersey, 12 months each year.
HOW USED ABOARD VESSEL -	Lifesaving equipment.

History of jackets bearing FTDU Identification Numbers 36 through 70.

Thirty-five (35) Model 2 Kapok Life Preservers.

MANUFACTURER -	Merit Manufacturing Company.
APPROVAL NO. -	No. 160.002/17/0.
DATE OF FACTORY INSP. -	Passed about March - April 1957
NAME & TYPE OF VESSEL -	Vessel: Motor Boat "Frisco" - Passenger Party Fishing Boat.
APPROX. TIME IN SERVICE -	2 Years
METHOD & PLACE OF STOWAGE -	Stowed on deck in box since 1958; prior to that they were stowed in cabin.
APPROX. TEMP. OF STOWAGE -	Normal outside temperature of Brielle, New Jersey, 12 months each year.
HOW USED ABOARD VESSEL -	Lifesaving equipment.

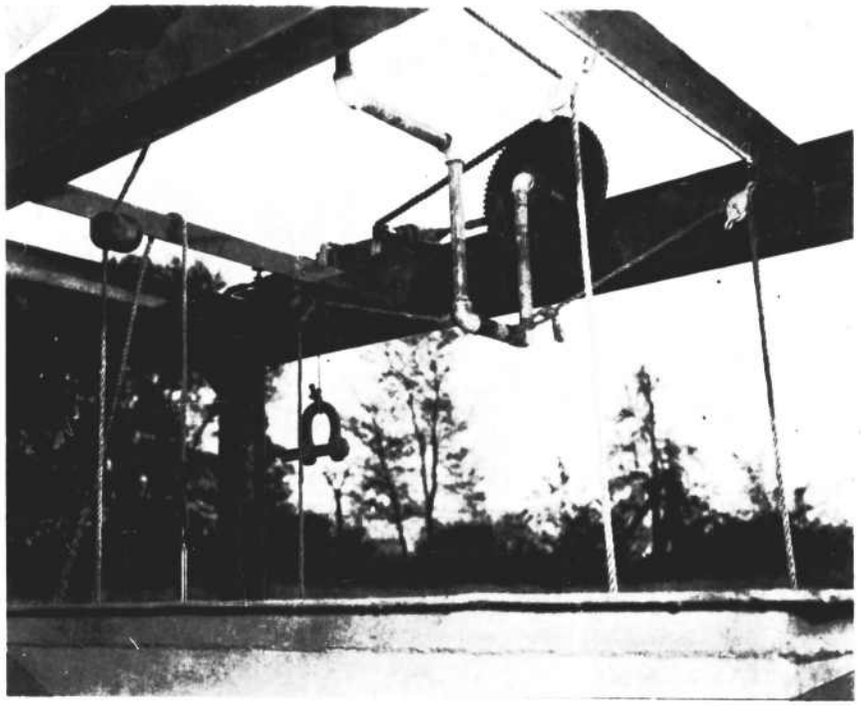


FIGURE 1

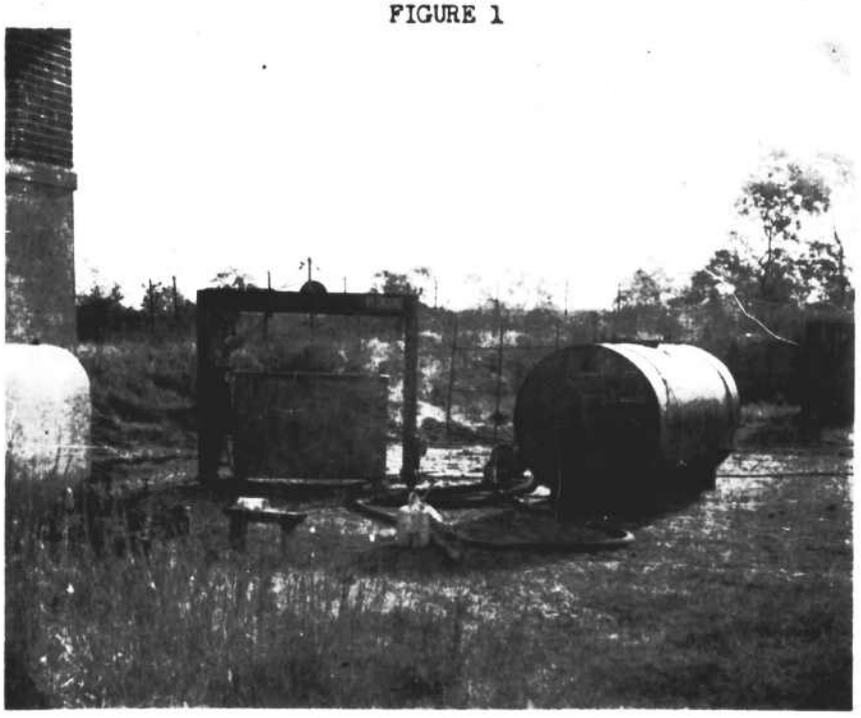


FIGURE 2
Overall View of Test Site and Equipment

FIGURE 3

6.2 Standard sea water was used throughout these tests. This water was obtained from the U. S. Navy Engineering Experimental Station at Annapolis and stowed in a tank adjacent to the test rig. The sea water used was taken from the Atlantic Ocean at a position 200 miles east of the Virginia Capes.

6.3 The jackets were tested in groups of ten (10); (five (5) each under five (5) years old and five each over five (5) years old) in the following manner:

6.3.1 Ten (10) jackets in plain sea water for 12 hours as a control test.

6.3.2 Ten (10) jackets in gasoline film on sea water for 12 hours as a control test.

6.3.3 Ten (10) jackets - ½ hour in gasoline film on sea water, then 11½ hours in plain sea water.

6.3.4 Ten (10) jackets - 1 hour gasoline film on sea water, then 11 hours in plain sea water.

6.3.5 Ten (10) jackets - ½ hour in kerosene film on sea water, then 11½ hours in plain sea water.

6.3.6 Ten (10) jackets - 1 hour in kerosene film on sea water, then 11 hours in plain sea water.

7. Test Results:

7.1 The results of these tests are presented in Tables 1 through 6, pages 11 through 16 inclusive, and graphically in Figures 4 through 15 on pages 17 through 28 inclusive. In the tables the FTDU identification number is given along with the original buoyancy, time to decrease to 16# buoyancy after removal of the test film, and buoyancy after 12 hours.

7.2 The original buoyancies show the older jackets to have from 19 to 24 pounds initial buoyancy while the newer jackets run a few pounds higher on initial buoyancy.

7.3 The control test in plain sea water (Table I, page 11) show the older jackets holding up much longer than the newer jackets. The time to reach 16 pounds for the older jackets averaging about 8 hours while for the newer jackets the time is about five (5) hours. The newer jackets in this test showed extremes of durability, one jacket failing after only 12 minutes and one jacket not failing at all. Final buoyancies for both old and new jackets were about the same.

7.4 In the control test using a gasoline film for the entire 12 hours of testing, we find that where some of the older jackets took several hours longer to fail. (Table 2, page 12), no set pattern was established to differentiate between the older and newer jackets. The rate of lose in buoyancy was somewhat less than in the plain sea water test. The final buoyancies again were about the same, i.e., 60% of the original buoyancies.

7.5 The test results for the ½ hour and 1 hour gasoline film on sea water show no discernable difference in the two tests due to the fact that the film remained on the sea water for ½ hour longer in the latter test. (Tables 3 and 4, pages 13 and 14). The rate of loss in buoyancy follows the same curve as the control test with gasoline film in both the ½ and 1 hour tests. In this case, however, the older jackets rate of loss of buoyancy is much greater than the newer jackets and was greater than rate of loss in either control test. Where only one of the newer jackets failed in the 1 hour gasoline film, three (3) failed in the ½ hour gasoline test. This shows a great divergence even in the jackets with the same history. In these two tests, the older jackets retained only 50 to 60% of their original buoyancies while the newer jackets retained as much as 65 to 75% of their original buoyancies.

7.6 In the ½ and 1 hour kerosene film tests the older jackets show a considerably greater rate of loss of buoyancy than the newer jackets; the final buoyancies being about the same as for the gasoline film tests. (Tables 5 and 6, pages 15 and 16). Again we find that the newer jackets show no set standard of behavior. Three jackets failed in the ½ hour test where there were no jackets which failed in the 1 hour test.

TABLE I
CONTROL TEST

TWELVE (12) HOUR AGITATION IN PLAIN SEA WATER

JACKET NO.	ORIGINAL BUOYANCY	TIME TO REACH 16 LBS.	BUOYANCY AFTER 12 HR.
	JACKETS OVER FIVE (5) YEARS OLD		
1	23.0 lbs	9 hr. 50 Min.	14.5 lbs
2	25.0 "	8 " 0 "	15.0 "
3	26.0 "	7 " 35 "	14.5 "
4	24.5 "	9 " 45 "	15.5 "
19	36.0 "	3 " 45 "	10.0 "
	JACKETS UNDER FIVE (5) YEARS OLD		
36	20.0 "	0 " 12 "	4.0 "
37	25.0 "	4 " 15 "	10.0 "
38	20.5 "	3 " 20 "	12.5 "
39	25.5 "	11 " 0 "	15.0 "
40	28.0 "	-	19.5 "

TABLE II
CONTROL TEST

TWELVE (12) HOUR AGITATION WITH GASOLINE FILM

JACKET NO.	ORIGINAL BUOYANCY	TIME TO REACH 16 LBS.	BUOYANCY AFTER 12 HRS.
JACKETS OVER FIVE (5) YEARS OLD			
5	31.0 lbs	- hr - Min	19.0 lbs.
6	22.5 "	8 " 40 "	15.5 "
7	26.0 "	-	17.5 "
8	24.0 "	7 " 40 "	14.0 "
20	24.5 "	1 " 35 "	5.5 "
JACKETS UNDER FIVE (5) YEARS OLD			
41	27.5 "	-	20.0 "
42	26.0 "	3 " 45 "	10.5 "
43	25.0 "	-	21.0 "
44	26.5 "	5 " 0 "	14.0 "
45	27.0 "	5 " 0 "	14.5 "

TABLE III
TWELVE (12) HOUR AGITATION

ONE-HALF (½) HOUR GASOLINE FILM ON SEA WATER

JACKET NO.	ORIGINAL BUOYANCY	BUOYANCY AFTER ½ HOUR	TIME TO REACH 16 LBS.	BUOYANCY AFTER 12 HOURS
11	26.0 lbs	20.5 lbs	1 hr-15 Min	11.0 lbs
12	24.0 "	13.0 "	0 " 13 "	2.5 "
13	24.0 "	17.5 "	1 " 0 "	9.0 "
14	19.5 "	11.5 "	0 " 11 "	0.5 "
21	23.0 "	19.5 "	3 " 0 "	13.5 "
46	23.5 "	22.5 "	10 " 0 "	15.0 "
47	28.5 "	26.0 "	-	20.5 "
48	23.0 "	21.5 "	7 " 0 "	13.0 "
49	28.0 "	26.5 "	-	21.0 "
50	24.0 "	21.0 "	4 " 0 "	12.5 "

TABLE IV
TWELVE (12) HOUR AGITATION

ONE (1) HOUR GASOLINE FILM ON SEA WATER

JACKETS OVER FIVE (5) YEARS OLD

JACKET NO.	ORIGINAL BUOYANCY	BUOYANCY AFTER 1 HOUR	TIME TO REACH 16 LBS	BUOYANCY AFTER 12 HOURS
22	20.0 lbs	19.5 lbs	5 hr-55 Min	14.5 lbs
23	22.0 "	19.0 "	3 " 0 "	11.5 "
24	18.5 "	15.0 "	0 " 50 "	11.5 "
25	24.5 "	23.5 "	8 " 35 "	14.5 "
26	25.5 "	20.0 "	3 " 0 "	13.0 "

JACKETS UNDER FIVE (5) YEARS OLD

51	28.0 "	24.5 "	-	21.5 "
52	26.5 "	22.5 "	-	18.5 "
53	24.5 "	19.0 "	4 " 05 "	15.0 "
54	27.5 "	25.0 "	-	18.0 "
55	29.0 "	26.5 "	-	22.5 "

TABLE V
TWELVE (12) HOUR AGITATION

ONE-HALF (½) HOUR KEROSENE FILM ON SEA WATER

JACKETS OVER FIVE (5) YEARS OLD

JACKET NO.	ORIGINAL BUOYANCY	BUOYANCY AFTER ½ HOUR	TIME TO REACH 16 LBS	BUOYANCY AFTER 12 HOURS
31	23.0 lbs	20.5 lbs	2 hr-0 Min	10.0 lbs
32	21.5 "	18.0 "	0 " 45 "	4.0 "
33	23.5 "	21.5 "	2 " 0 "	6.0 "
34	24.0 "	21.5 "	2 " 20 "	10.5 "
27	23.5 "	23.0 "	10 " 40 "	13.5 "

JACKETS UNDER FIVE (5) YEARS OLD

56	25.5 "	24.0 "	10 " 40 "	15.0 "
57	28.0 "	27.0 "	-	18.0 "
58	24.0 "	22.5 "	3 " 0 "	11.5 "
59	26.5 "	25.0 "	4 " 0 "	11.0 "
60	26.0 "	25.5 "	-	20.0 "

TABLE VI
TWELVE (12) HOUR AGITATION

ONE (1) HOUR KEROSENE FILM ON SEA WATER

JACKETS OVER FIVE (5) YEARS OLD

JACKET NO.	ORIGINAL BUOYANCY	BUOYANCY AFTER ONE (1) HOUR	TIME TO REACH 16 LBS	BUOYANCY AFTER 12 HOURS
28	19.5 lbs	18.0 lbs	2 Hr-30 Min	9.5 lbs
29	22.0 "	19.0 "	2 " 50 "	10.5 "
30	19.0 "	17.0 "	1 " 25 "	9.0 "
35	18.5 "	16.5 "	1 " 5 "	9.5 "
10	22.0 "	20.0 "	5 " 0 "	14.0 "

JACKETS UNDER FIVE (5) YEARS OLD

61	28.0 "	26.0 "	-	19.0 "
62	29.5 "	26.0 "	-	22.0 "
63	24.5 "	23.0 "	-	18.5 "
64	26.0 "	24.0 "	-	17.5 "
65	26.0 "	25.5 "	-	18.5 "

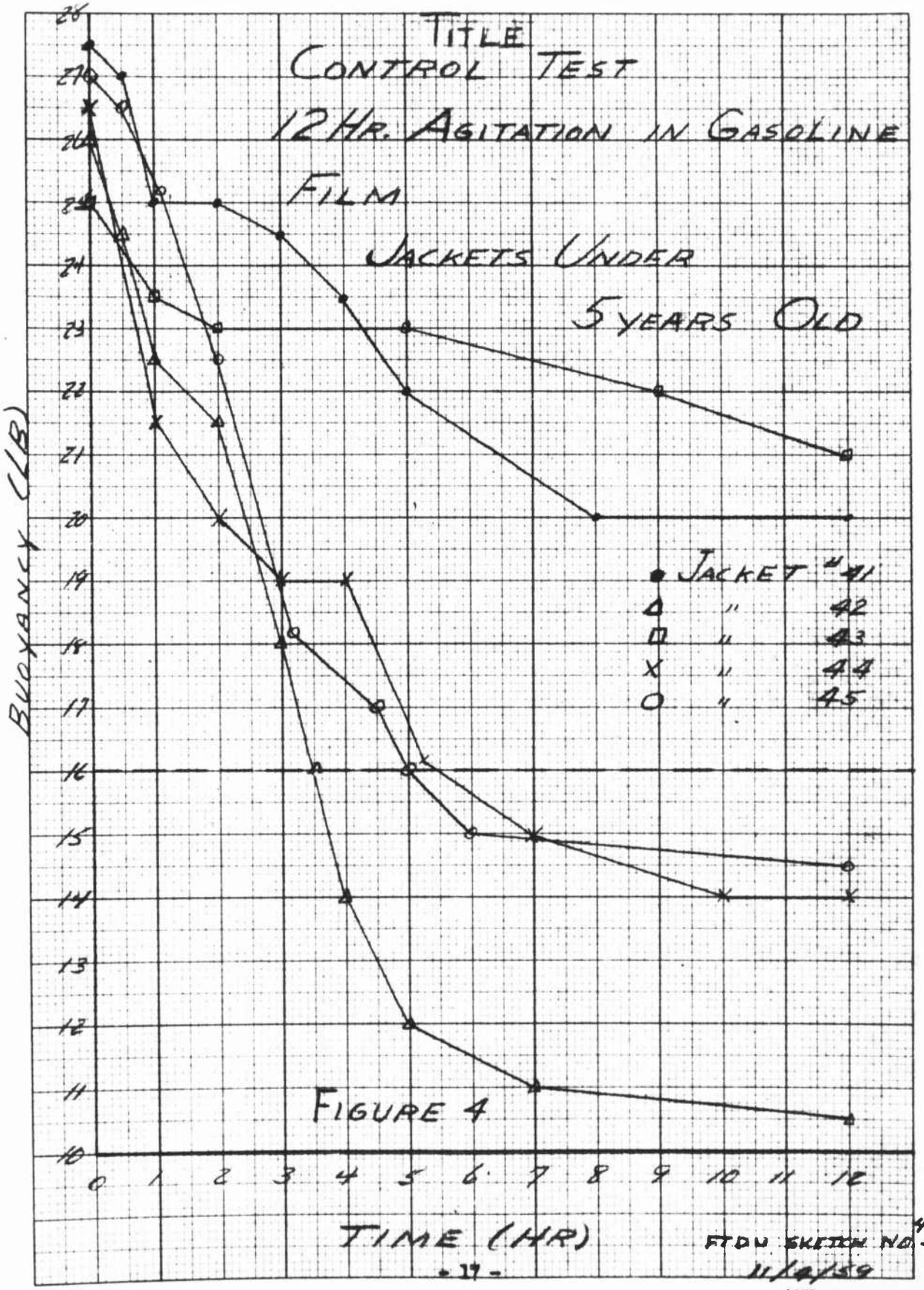


FIGURE 4

FTDU SKETCH NO 496
11/4/59
J.T.G.

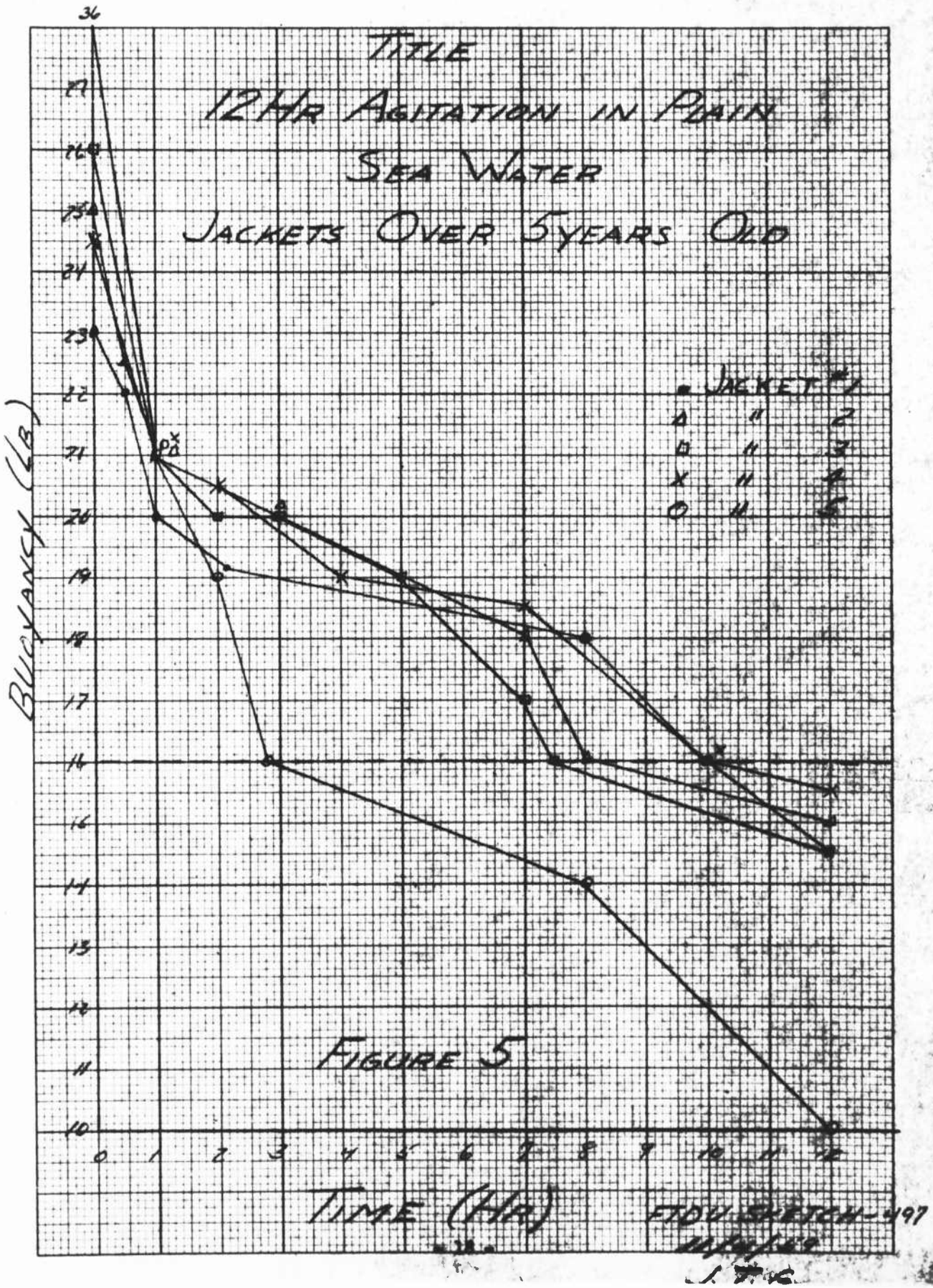
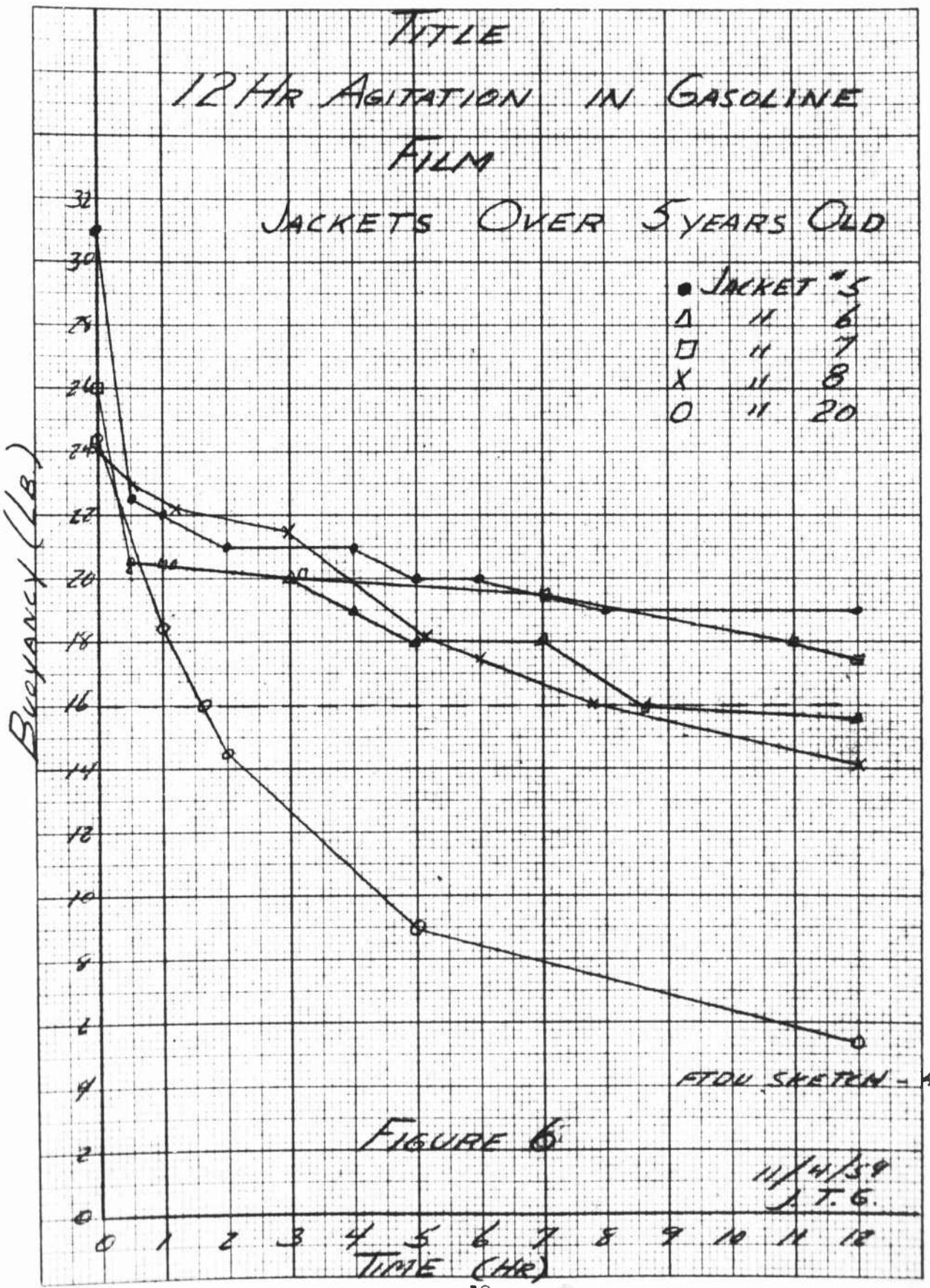

TITLE
12 HR AGITATION IN PLAIN SEA WATER
JACKETS OVER 5 YEARS OLD
JACKET #1
" 2
" 3
" 4
" 5
BUOYANCY (LB)
TIME (HR)
36
27
26
25
24
23
22
21
20
19
18
17
16
15
14
13
12
11
10
0
1
2
3
4
5
6
7
8
9
10
11
12

FIGURE 5


TITLE
12 HR AGITATION IN GASOLINE
FILM
JACKETS OVER 5 YEARS OLD
● JACKET #5
Δ " 6
□ " 7
X " 8
O " 20
BUOYANCY (LB.)
TIME (HR)
FTOV SKETCH - 498
FIGURE 6
11/4/59
J. T. G.

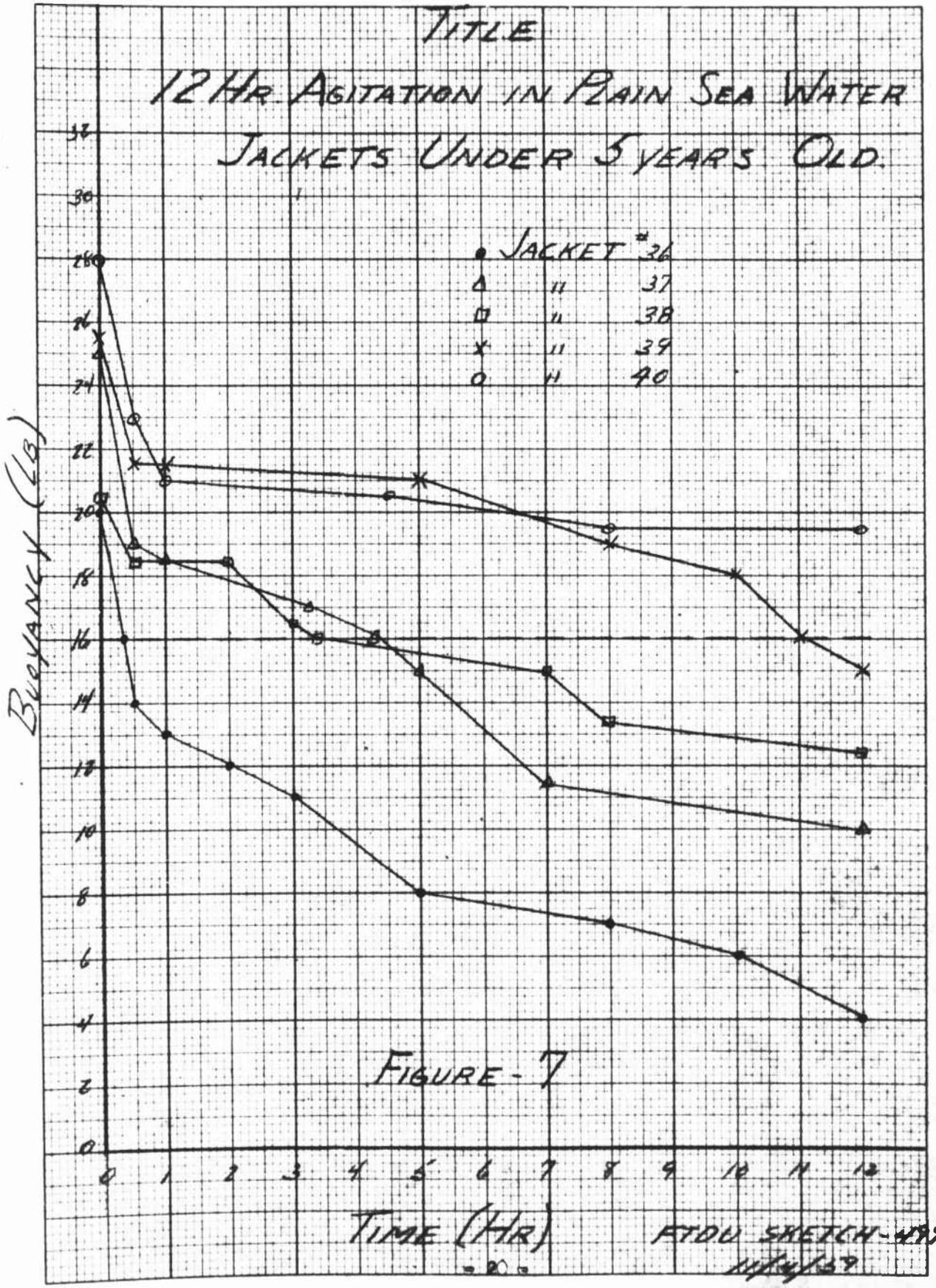


FIGURE - 7

FTOU SKETCH-479

J. T. G.

TITLE

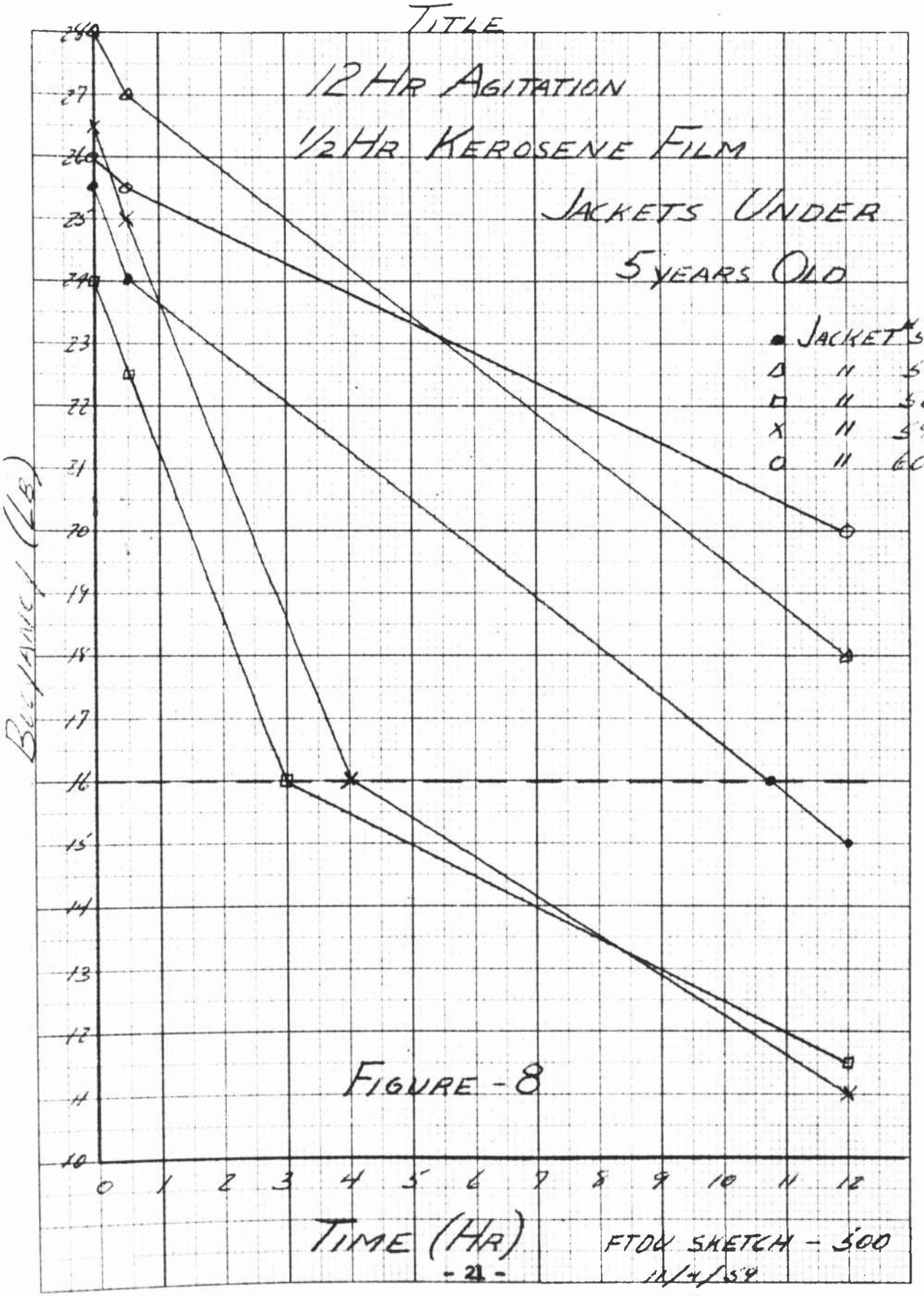


FIGURE - 8

FTOU SKETCH - 500
12/4/59
I T G

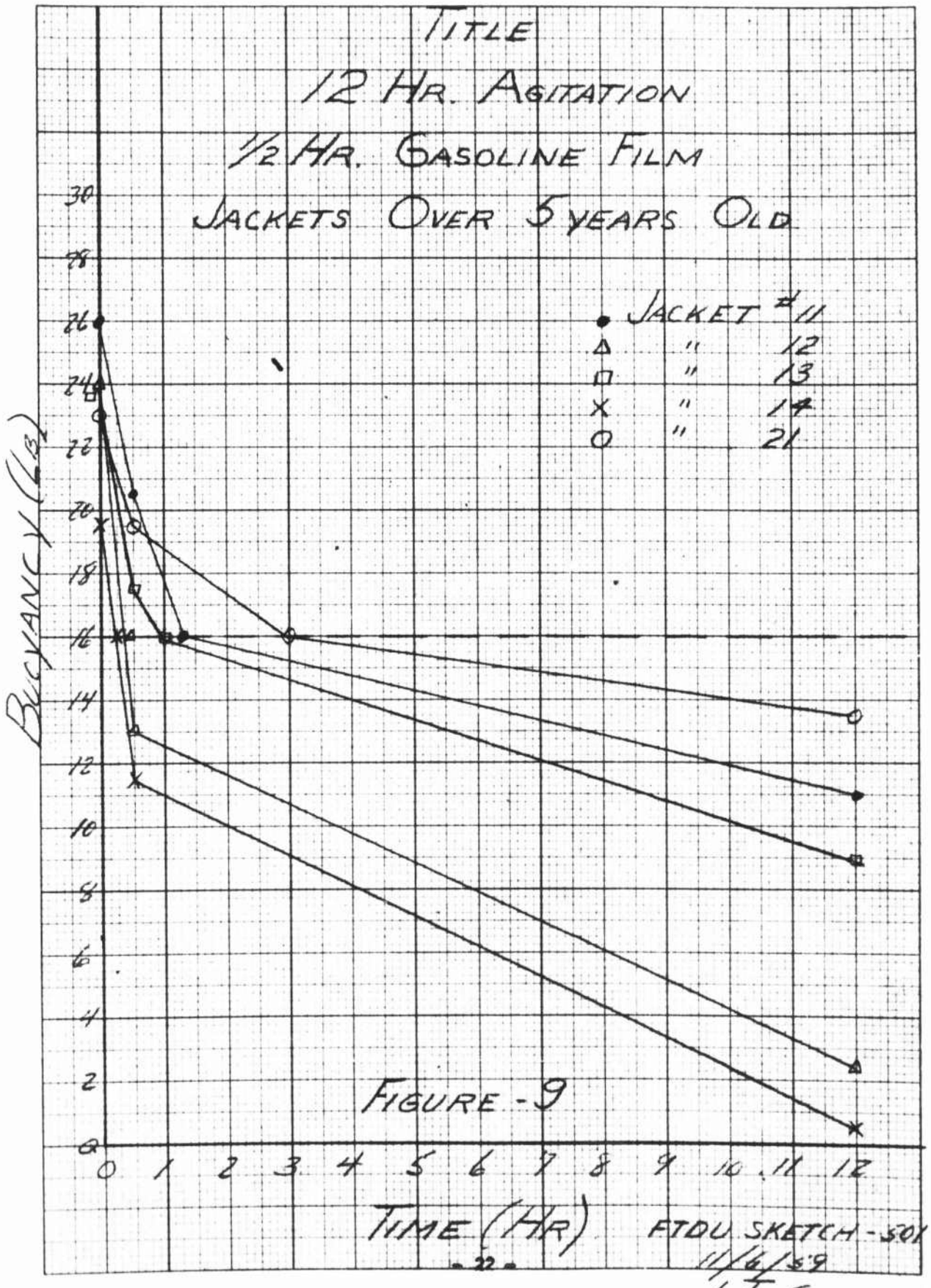


FIGURE - 9

FTDU SKETCH - 501
11/6/59
J. T. G.

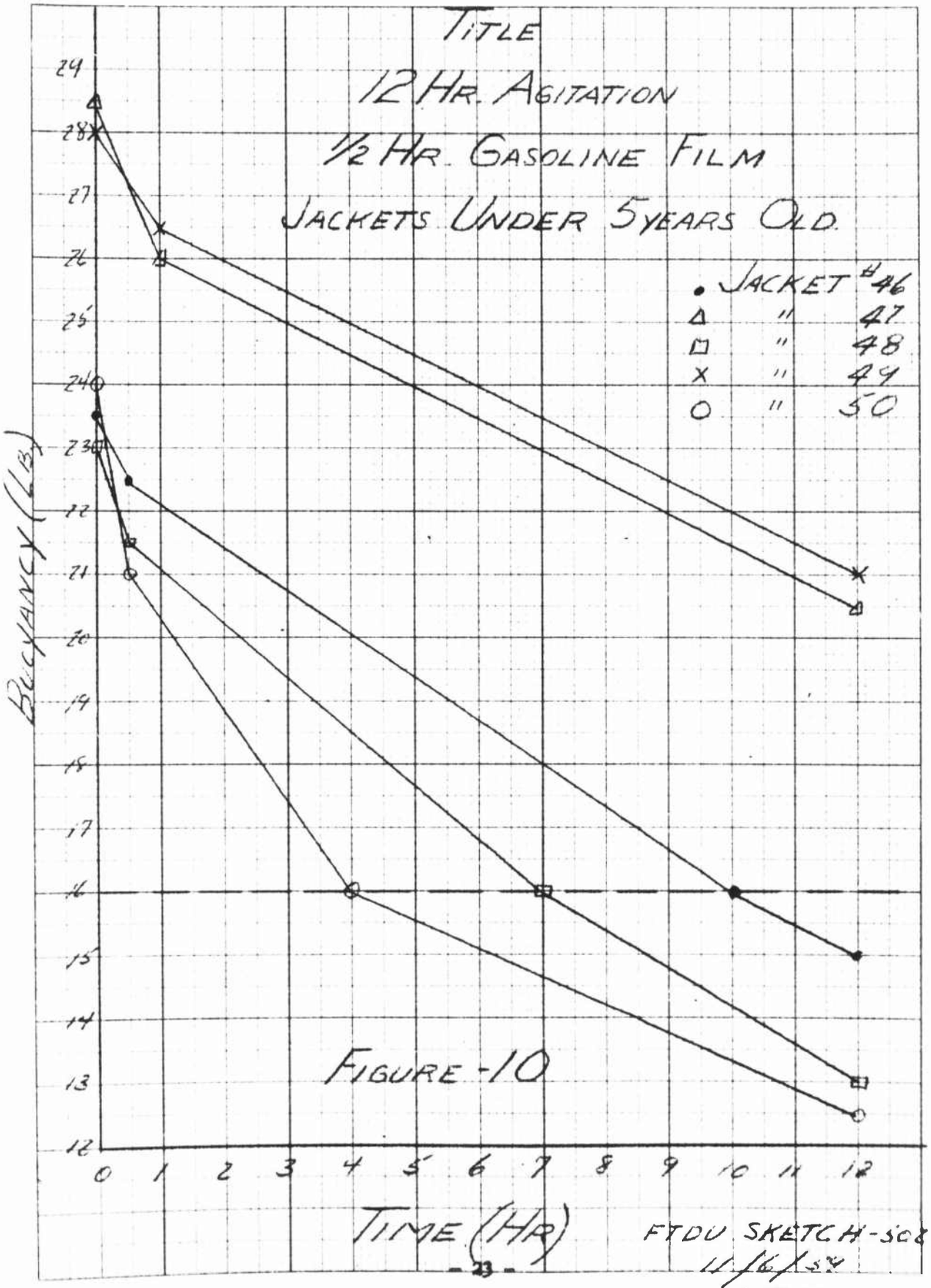


FIGURE -10

FTDU SKETCH-502
11/16/54
J. T. G.

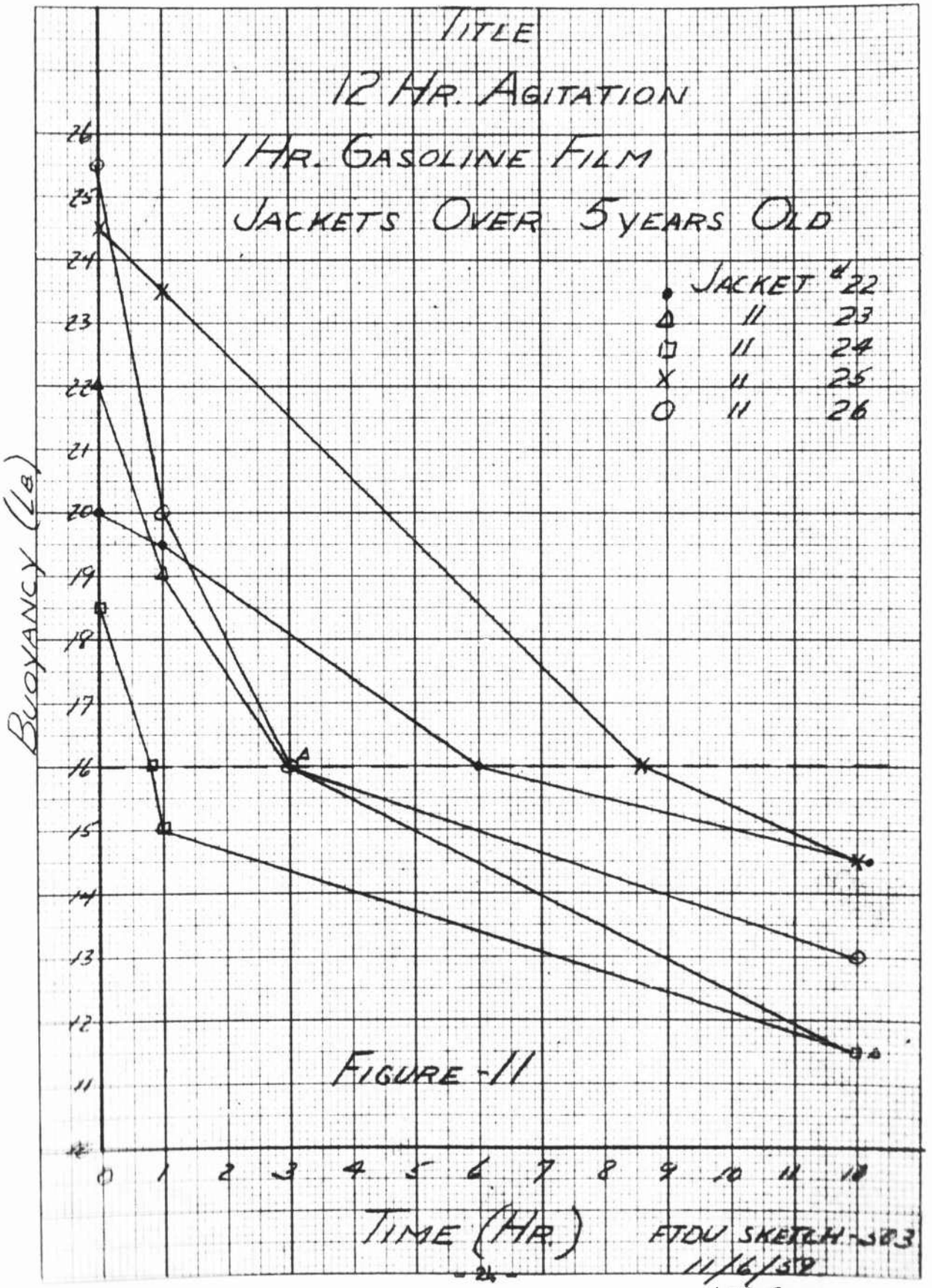


FIGURE -11

FTOU SKETCH-383
11/6/52
J.T.G.

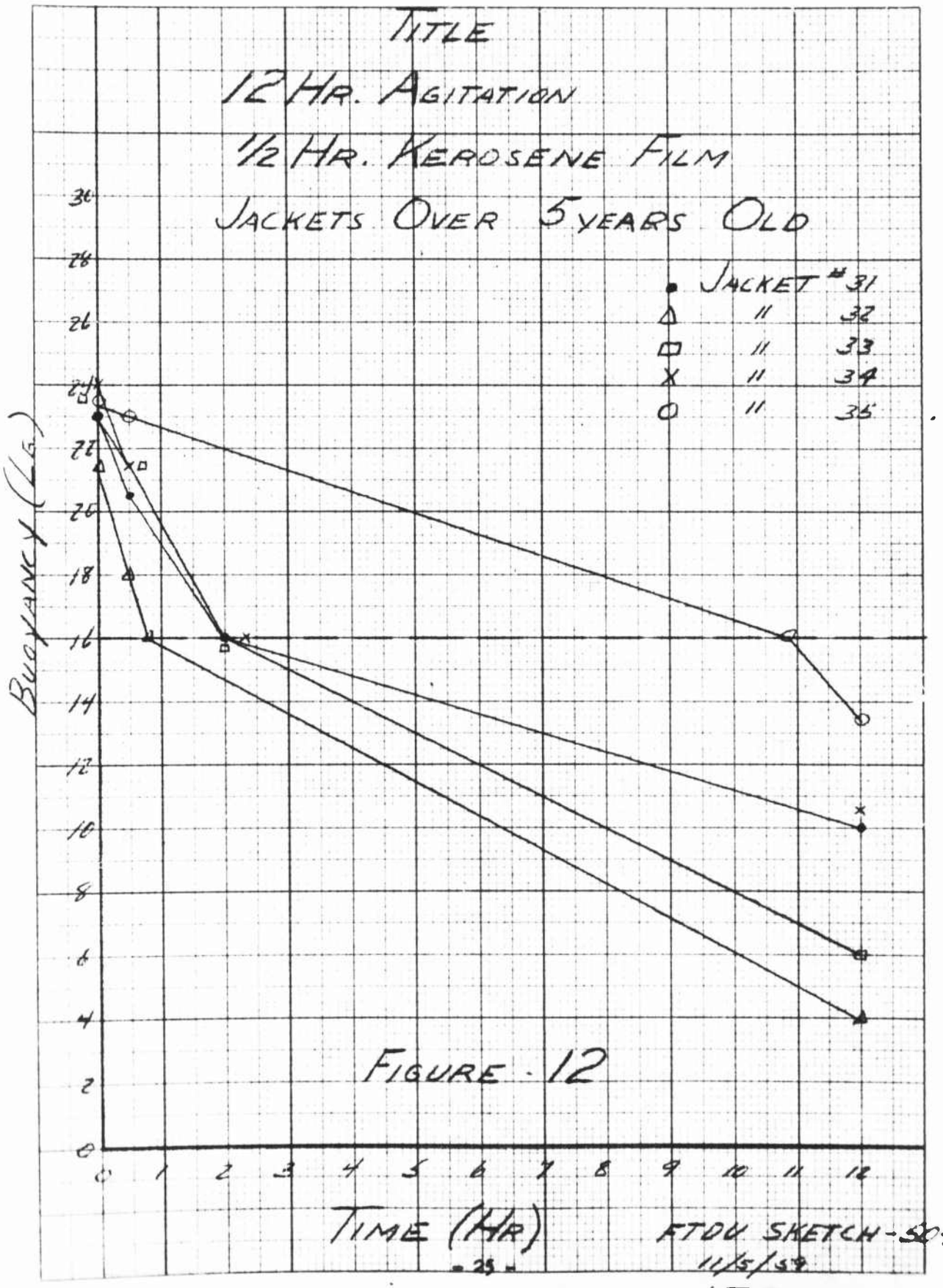


FIGURE - 12

FTOU SKETCH - 504
11/5/58
J. T. G.

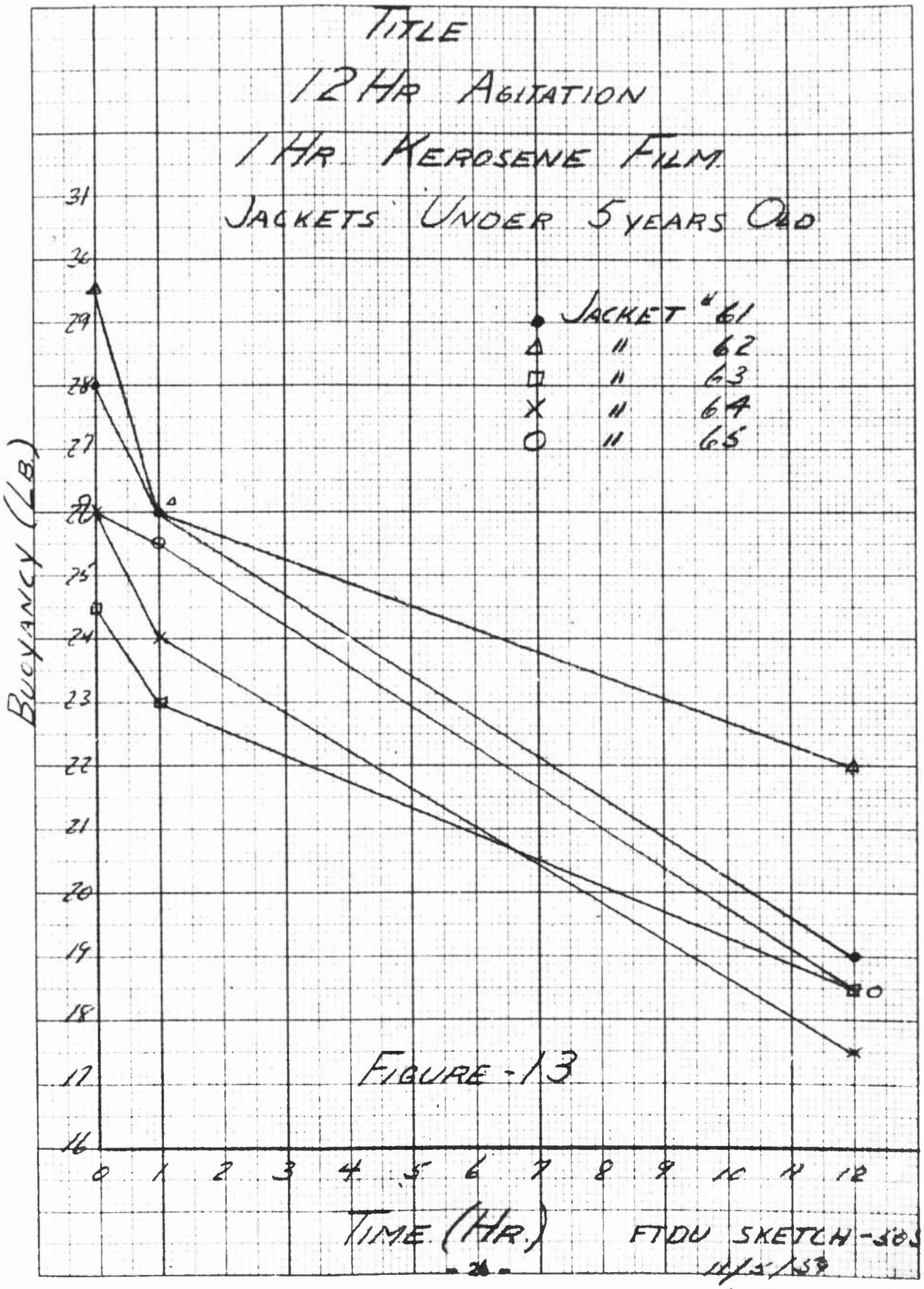


FIGURE - 13

FTDU SKETCH - 585
11/5/65
J. T. G.

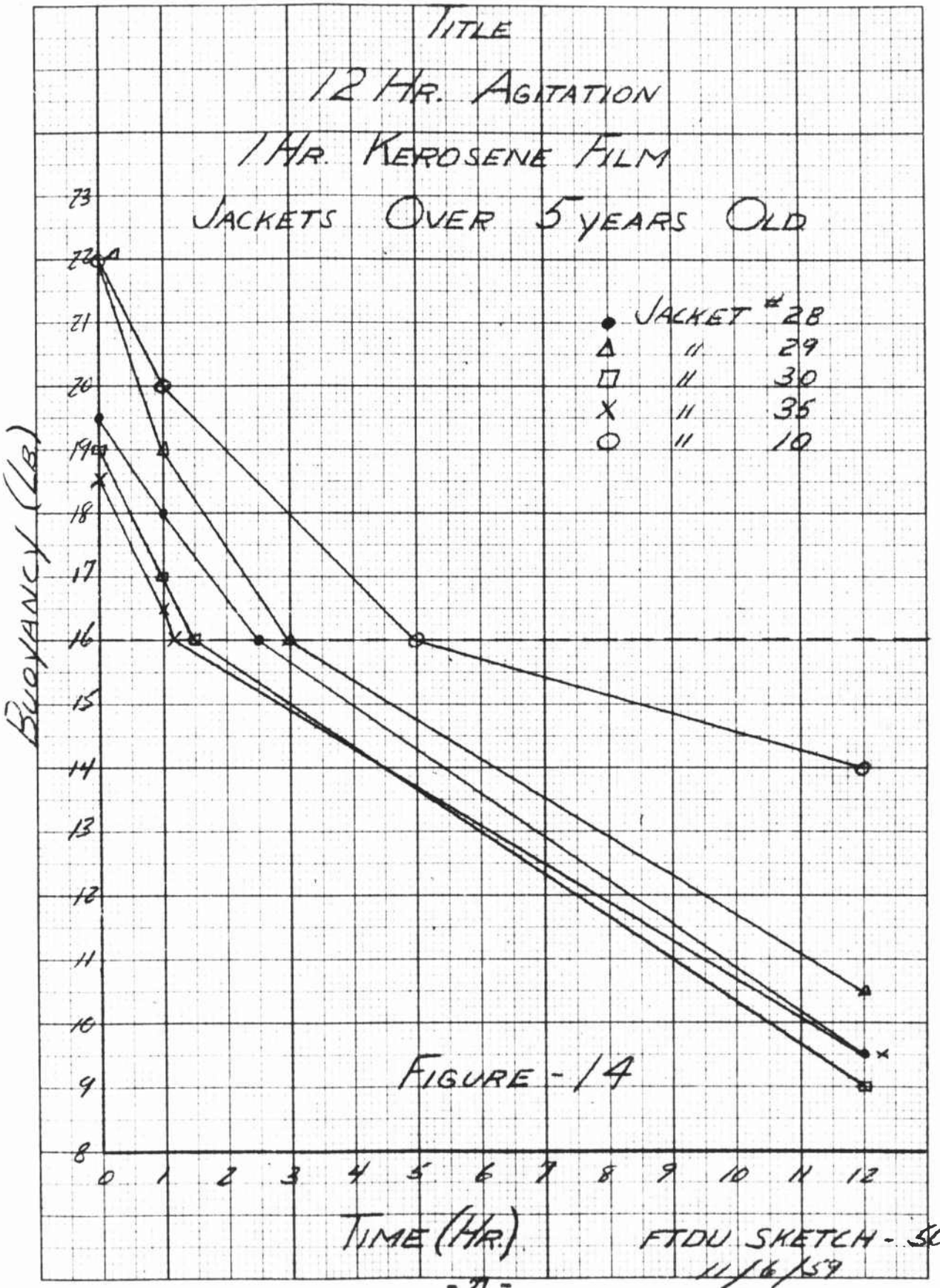


FIGURE - 14

FTDU SKETCH - 506
11/16/59
J.T.G.

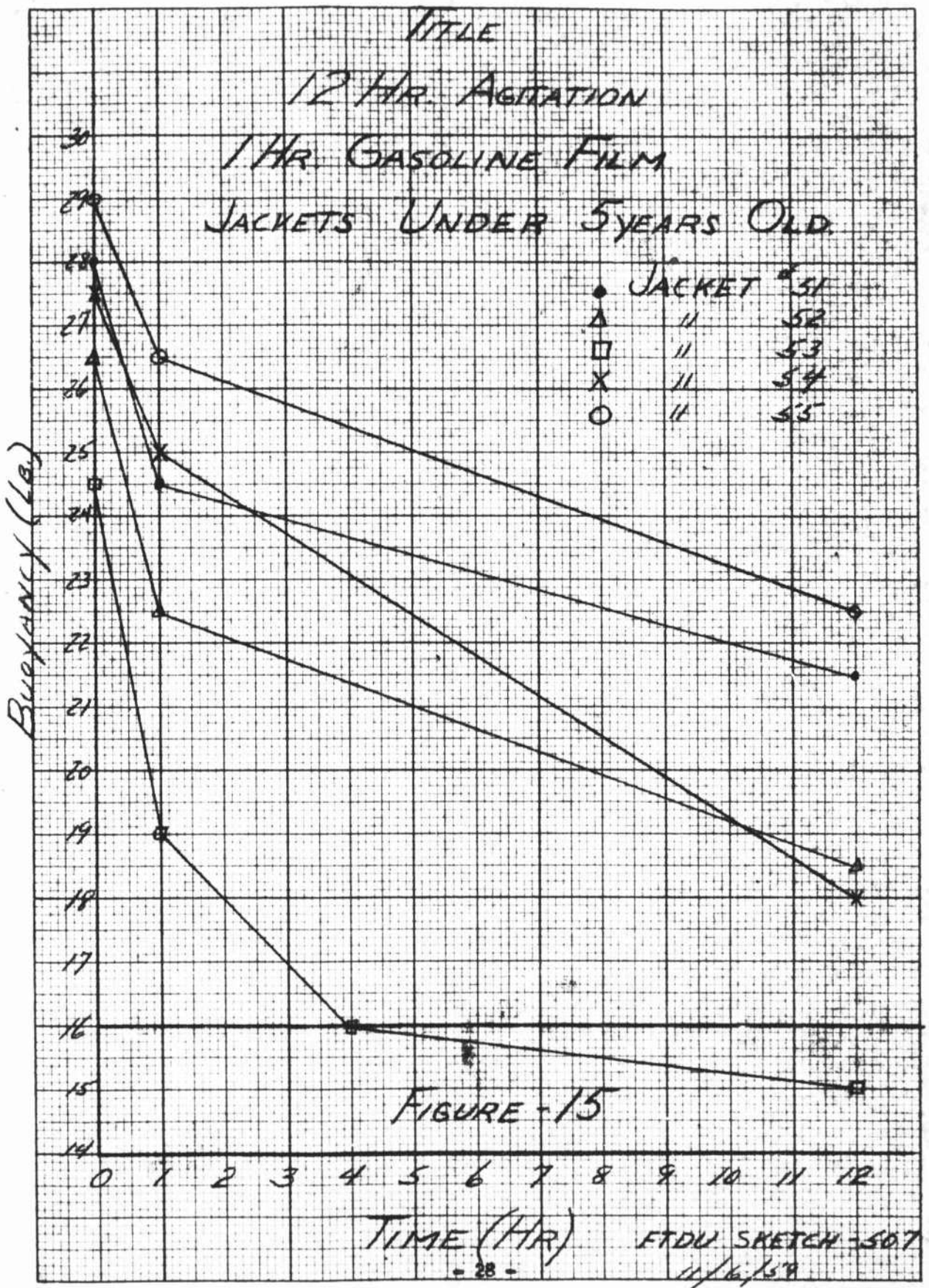


FIGURE - 15

FTDU SKETCH - 507
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J. T. G.

8. Discussion of Results:

8.1 From the results obtained in these tests it is apparent that the newer jackets displayed no set pattern of behavior. There was no way of determining a typical curve. While they generally faired better than the older jackets, there were certain instances when they gave inferior performance compared to the older jackets.

8.2 The older jackets did follow a typical pattern, although it was not in keeping with previous tests. The jackets lasted longer in the 12 hour gasoline film test than in the ½ hour gasoline film test. There is also this same contradiction between the two control tests.

8.3 Previous tests indicated that gasoline and fuel oil films had a pronounced adverse effect upon the buoyancy retention of Kapok life preservers. The present test results are surprising in that they do not follow the same trend. All that is definitely shown is that about 90% of the older jackets and about 50% of the newer jackets will fail in less than 12 hours when agitated in sea water (with or without gasoline and fuel oil films). Even jackets with apparently the same history show large differences in performance. Possible explanations for this are packing of Kapok in some jackets due to compression in storage and loss of water repellants in fabric envelopes caused by chafing or abrasion.